

Urban Runoff: Controlling the Complex

A California WMMS takes an integrated, watershed-based approach to identifying cost-effective projects

By Youn Sim, Ph.D., P.E.

With thousands of permitted as well as nonpoint source discharges entering the receiving waters of Los Angeles County, Calif., improving the water quality of the region's coastal watersheds is a significant undertaking.

To help public and private entities address the challenge of managing urban storm water and runoff in a complex environment, the Los

Angeles County Flood Control District (LACFCD) has developed the Watershed Management Modeling System (WMMS). The WMMS identifies cost-effective projects through an integrated, watershed-based approach.

TMDLs

Coastal watersheds in Los Angeles County comprise nearly 3,100 sq

miles. Major surface waters originate from pristine mountains in the north, flowing to the Pacific Ocean through urbanized foothill and valley areas and high-density residential and industrial coastal areas. They terminate at highly utilized beaches and harbors.

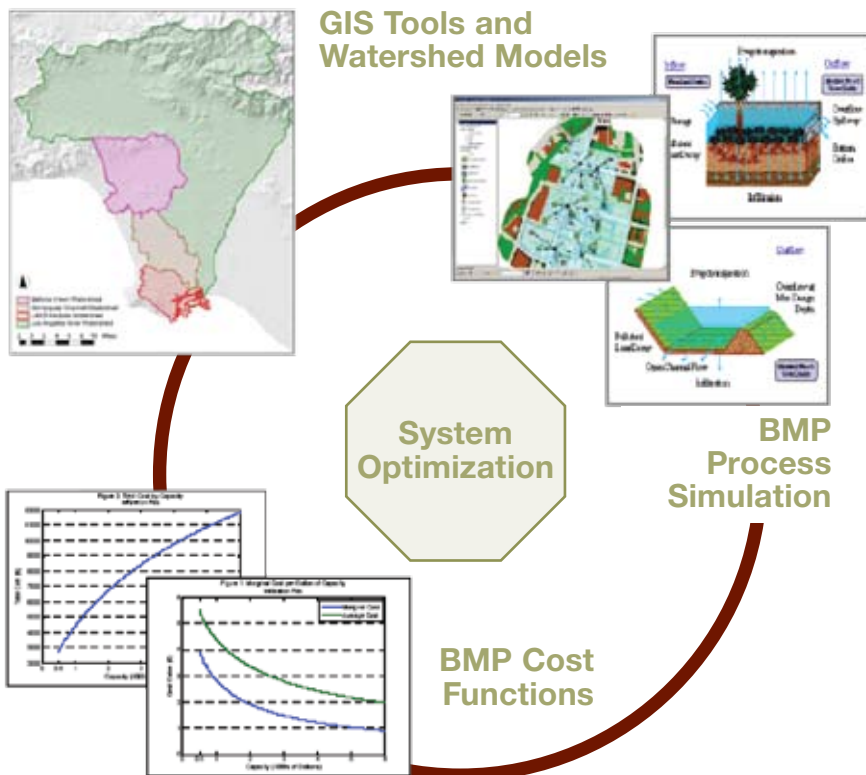
To date, water bodies within the county have been prescribed 23 total maximum daily loads (TMDLs), including trash, metals, toxic pollutants, bacteria, nutrients and chlorides. Within the next few years, approximately 30 additional TMDLs are expected to be established. TMDLs of most pollutants are allocated to publicly owned treatment works, municipal separate storm sewer systems (MS4s), the California Department of Transportation and industrial and construction sites.

Most TMDLs have both point and nonpoint source components. Typical nonpoint sources identified in the TMDLs are aerial deposition, natural sources (e.g., forests and birds) and urban runoff. Because the county's six major watersheds are highly urbanized, a majority of storm water pollutants stem from nonpoint sources.

Challenges & Approach

TMDLs for Los Angeles County water bodies are allocated mostly to storm drain outlets. Because there are thousands of drain outlets, TMDL compliance often is based on water quality measured at receiving waters instead of quantifying total loads at all storm drain outlets.

WMMS Structure



In addition to the discharges permitted by the MS4, a variety more occur daily under 5,600 active National Pollutant Discharge Elimination System permits issued by state regulatory agencies. Consequently, it is nearly impossible to demonstrate the water quality improvement effect as a result of individual management actions toward TMDL compliance at the receiving waters.

A watershed-based approach is needed to address the water quality of entire watersheds. In this approach, collective impact of a variety of pollutant sources—from point to nonpoint—is evaluated; thereby comprehensive, long-term strategies for overall water quality improvement of the entire watershed can be planned.

LACFCD Goals

As a regional agency that serves most county areas, the LACFCD is developing the WMMS as an effective storm water management and planning tool for all of its coastal watersheds.

The WMMS simulates hydrologic and pollutant transport processes and subsequently identifies cost-effective combinations of local-scale and watershed-scale best management practices (BMPs). Local-scale BMPs, often referred to as low-impact development (LID)-type BMPs, present a viable option for individual cities to control pollution at the source. Watershed-scale BMPs treat residual runoff from the entire watershed.

Although similar attempts have been made in other parts of the country, the scale and level of detail of the WMMS is unprecedented. It is the first modeling system of its kind to account for parcel-scale details of hydrologic pollutant transport and BMP processes while encompassing 3,000 sq miles of coastal watersheds.

Built on an extensive body of relevant studies in the Los Angeles region and a state-of-the-art optimization technique, the WMMS provides a unique framework in which managers can evaluate alternative

storm water BMPs and LID methods. An optimized solution to a specific management objective can be identified based on benefits and costs.

Using the integrated, watershed-based approach, the WMMS will help decision makers develop projects that achieve overall watershed goals while recognizing needs of individual municipalities and other public and private entities within the watershed. The model results will be presented in terms of type and quantity of BMPs allocated to specific parcel land uses.

The WMMS and its results will be made available to the public. Using the modeling system, different entities within the watershed can cooperatively develop cost-effective and mutually beneficial solutions that address multiple issues, including water quality, water conservation, flood protection and open-space development. This eventually will lead to effective watershed-based storm water management.

Specific project goals include:

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- Develop for all major watersheds within the county boundary a WMMS that simulates hydrologic and pollutant generation and transport processes;
- Provide a comprehensive list of cost-effective local- and watershed-scale BMP solutions that can be used to develop multipollutant TMDL implementation plans for all county watersheds;
- Provide LID technical guidance for new and redevelopment projects by quantifying water conservation and pollution reduction benefits; and
- Develop a watershed management tool for future planning of multibenefit projects involving water quality, flood control, water conservation and open-space development components.

Project Components

The project includes the use of WMMS based on the U.S. Environmental Protection Agency's watershed models as well as a BMP selection system based on an optimization algorithm.

In terms of specific TMDL compliance strategies, LACFCD will recommend a thorough list of optimally selected, cost-effective BMP projects, estimated pollution load reduction and associated costs. The district also will follow continuous updates of watershed condition and subsequent BMP adjustment based on data from the countywide monitoring plan.

The WMMS Advantage

The project has helped the LACFCD realize four main benefits:

1. Providing a system for phased BMP implementation, with quantified pollutant load reduction to be achieved;
2. Integrating watershed management that offers benefits on top of those of water quality;
3. Allowing for an iterative, adaptive approach to water quality goals through continuous refinement and improvement of selected BMP solutions; and
4. Making information available to cities for their planning. SWS

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